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Inventors(s): Tetsuya TOSHINE et al.

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ACCURATE TRANSLATION OF PRIORITY DOCUMENT

The undersigned, of the below address, hereby states that he/she well knows both the English and Japanese languages, and that the attached is an accurate translation into the English language of the Certified Copy, filed for this application under 35 U.S.C. Section 119 and/or 365, of:

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Signature:

Name: Yukiaki NAKAISHI

Address: 4-24, Kawatsuru 2-chome,
Kawagoe-shi, SAITAMA
350-1176 JAPAN

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This is to certify that annexed is a true copy of the following application as filed with this Office.

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Applicant(s) : DAI NIPPON PRINTING CO., LTD.

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[INVENTOR]	Tetsuya TOSHINE : c/o DAI NIPPON PRINTING CO., LTD., 1-1, Ichigaya-Kagacho 1-Chome, Shinjuku-Ku, TOKYO
[INVENTOR]	Hiroyuki OHTAKI : c/o DAI NIPPON PRINTING CO., LTD., 1-1, Ichigaya-Kagacho 1-Chome, Shinjuku-Ku, TOKYO
[INVENTOR]	Kenji UEDA : c/o DAI NIPPON PRINTING CO., LTD., 1-1, Ichigaya-Kagacho 1-Chome, Shinjuku-Ku, TOKYO
[APPLICANT]	Identification Number : 000002897 DAI NIPPON PRINTING CO., LTD. :
[ATTORNEY]	Identification Number : 100095120 Patent Attorney : Nobuhiko UCHIDA
[ATTORNEY]	Identification Number : 100088041 Patent Attorney : Ryukichi ABE
[ATTORNEY]	Identification Number : 100092495 Patent Attorney : Masanobu HIRUKAWA

[ATTORNEY]	Identification Number : 100092509 Patent Attorney : Hiroki SHIRAI
[ATTORNEY]	Identification Number : 100095980 Patent Attorney : Hideo SUGAI
[ATTORNEY]	Identification Number : 100094787 Patent Attorney : Kenji AOKI
[ATTORNEY]	Identification Number : 100097777 Patent Attorney : Hiroshi NIRASAWA
[ATTORNEY]	Identification Number : 100091971 Patent Attorney : Akira YONEZAWA
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SPECIFICATION

TITLE OF THE INVENTION

HOLOGRAM TRANSFER FOIL, AND HOLOGRAM TRANSFER FOIL PRODUCTION PROCESS

SCOPE OF WHAT IS CLAIMED

1. A hologram transfer foil comprising a substrate and a transfer layer laminated thereon, said transfer layer comprising a surface protective layer, a first heat seal layer having a softening point of 55°C to 200°C, a hologram layer and a second heat seal layer having a softening point of 50°C to 195°C in this order, wherein the softening point of the first heat seal layer is at least 5°C higher than the softening point of the second heat seal layer, and at the time when said hologram transfer foil is applied on said heat seal layer side to an application member, the peel force between said substrate and said surface protective layer is smaller than that between adjacent layers in other layers.

2. The hologram transfer foil of claim 1, characterized in that the hologram layer is a volume hologram layer.

3. The hologram transfer foil of claim 1, characterized in that the hologram layer is a surface relief hologram layer.

4. A process for the production of a hologram transfer foil as recited in claim 1, characterized in that the first and second heat seal layers are each laminated on the hologram layer by means of dry lamination.

DETAILED EXPLANATION OF THE INVENTION

[0001]

ART FIELD TO WHICH THE INVENTION PERTAINS

The present invention relates to a hologram transfer foil which enables a hologram to be applied to any desired application member, and a hologram transfer foil production process.

[0002]

PRIOR ART

A hologram provides a means capable of recording information in its thickness direction, and recording and reconstructing three-dimensional images. Holograms are now fabricated by known fabrication processes. Typically, the holograms are used for prevention of illegal copying of ID cards, bank cards, etc., because they are fabricated by precise operations using optical equipment and so are very difficult to fake. In addition, the holograms are expressed in interference colors of light and so have an outside appearance hardly achievable by other imaging means.

[0003]

In a typical application taking full advantage of the aforesaid features of holograms, a hologram adhesive label, obtained in a film form with an adhesive attached thereto, is applied to a variety of associated members. Such a hologram adhesive label has a multilayer structure generally comprising a release sheet/adhesive layer/hologram layer/surface protective layer/substrate. The surface protective layer is provided for the purpose of protecting the hologram recorded in the hologram layer. Usually, such a surface protective layer contains various additives with a view to imparting thereto hard coatability, printability, slip capability, etc. However, the direct provision of such a surface protective layer onto the hologram layer is not preferable for both a transfer foil and an application member with a hologram transferred thereto by the transfer foil, because the migration of low-molecular-weight components such as solvents and surfactants from the surface protective layer into the hologram layer or the migration of low-molecular-weight components such as monomers and solvents in the hologram layer causes disorder in the reconstructed hologram image, etc.

[0004]

PROBLEM TO BE SOLVED BY THE INVENTION

A primary object of the present invention is to provide a hologram transfer foil which enables a hologram image, etc. to be reconstructed in an uninterrupted manner, and a

hologram transfer foil production process that is improved in terms of productivity.

[0005]

MEANS FOR SOLVING THE PROBLEM

The present invention provides a hologram transfer foil comprising a substrate and a transfer layer laminated thereon, said transfer layer comprising a surface protective layer, a first heat seal layer having a softening point of 55°C to 200°C, a hologram layer and a second heat seal layer having a softening point of 50°C to 195°C in this order, wherein the softening point of the first heat seal layer is at least 5°C higher than the softening point of the second heat seal layer, and at the time when said hologram transfer foil is applied on said heat seal layer side to an application member, the peel force between said substrate and said surface protective layer is smaller than that between adjacent layers in other layers.

[0006]

The hologram transfer foil is characterized in that the hologram layer is a volume hologram layer.

[0007]

The hologram transfer foil is characterized in that the hologram layer is a surface relief hologram layer.

[0008]

According to the present invention, there is provided a process for the production of a hologram transfer foil, characterized in that the first and second heat seal layers are each laminated on the hologram layer by means of dry lamination.

[0009]

EMBODIMENTS OF THE INVENTION

A section of one embodiment of the hologram transfer foil of the present invention is shown in Fig. 1 wherein reference numeral 1 represents a hologram transfer foil, 2 a hologram layer, 3 a second heat seal layer, 4 a first heat seal layer layer, 5 a surface protective layer, 6 a substrate, and 7 a releasable sheet. When the hologram layer 2 is a surface relief type hologram layer, a reflective layer

may be interposed between the hologram layer 2 and the second heat seal layer 3.

[0010]

Reference is now made to the substrate forming part of the hologram transfer foil according to the present invention and the material forming each layer. For the substrate 6, for instance, use may be made of polyethylene terephthalate (PET) films, polyvinyl chloride (PVC) films, polyvinylidene chloride films, polyethylene films, polypropylene films, polycarbonate films, cellophane films, acetate films, nylon films, polyvinyl alcohol films, polyamide films, polyamide-imide films, ethylene-vinyl alcohol copolymer films, polymethyl methacrylate (PMMA) films, polyether sulfone films and polyether ether ketone (PEEK) films. The substrate 6 has a thickness of usually about 5 to 200 μm, and preferably 10 to 50 μm, and may be either transparent or opaque. It is here noted that the substrate is released off after the transfer layer is transferred from the hologram transfer foil onto the application member. The substrate may be transparent or opaque, and be used in a sheet or carrier tape form.

[0011]

The hologram layer 2 may be made up of either a volume hologram or a surface relief hologram. An account is given of the case where the hologram layer 2 is made up of a volume hologram layer. To fabricate a volume hologram, a volume hologram-forming material is coated on a temporary substrate such as one represented by substrate 6 to form a hologram-forming layer. Then, interference fringes equivalent to the wavefronts of light from an object are recorded in the hologram-recording layer in the form of transmittance modulation or refractive index modulation. For replication, the hologram-recording layer should be in close contact with a master volume hologram, followed by exposure and development.

[0012]

For the volume hologram layer-forming material, all known volume hologram-recording materials inclusive of silver

salts materials, dichromated gelatin emulsions, photo-polymerizable resins and photo-crosslinkable resins may be used. In particular, preference is given to photosensitive materials designed for recording of dry volume holograms, comprising a matrix polymer, a photo-polymerizable compound, a photo-polymerization initiator and a sensitizing dye.

[0013]

The photo-polymerizable compounds used herein, for instance, include photo-polymerizable, photo-linkable monomers, oligomers and prepolymers, each containing at least one ethylenical unsaturated bond per molecule as will be explained later, which may be used alone or in admixture. Exemplary compounds are unsaturated carboxylic acids or their salts, esters of unsaturated carboxylic acids and aliphatic polyvalent alcohol compounds, and amide combined products of unsaturated carboxylic acids and aliphatic polyvalent amine compounds.

[0014]

Exemplary unsaturated carboxylic acid monomers are acrylic acid, methacrylic acid, itaconic acid, crotonic acid, isocrotonic acid and maleic acid as well as their halogen-substituted unsaturated carboxylic acids such as chlorinated unsaturated carboxylic acids, brominated unsaturated carboxylic acids and fluorinated unsaturated carboxylic acids. Examples of the salts of unsaturated carboxylic acids are sodium, potassium or like salts of the aforesaid acids.

[0015]

The ester monomers of aliphatic polyvalent alcohol compounds and unsaturated carboxylic acids may include those classified as acrylic acid esters, for instance, ethylene glycol diacrylate, triethylene glycol diacrylate, 1,3-butanediol diacrylate, tetramethylene glycol diacrylate, propylene glycol diacrylate, neopentyl glycol diacrylate, trimethylolprpane triacrylate, trimethylolpropane tri (acryloyloxypropyl) ether, trimethylolethane triacrylate, hexanediol diacrylate, 1,4-cyclohexanediol diacrylate, tetraethylene glycol diacrylate, pentaerythritol diacrylate, pentaerythritol triacrylate, pentaerythritol tetraacrylate,

dipentaerythritol diacrylate, dipentaerythritol triacrylate, dipentaerythritol tetraacrylate, dipentaerythritol hexaacrylate, sorbitol triacrylate, sorbitol tetraacrylate, sorbitol pentaacrylate, sorbitol hexaacrylate, tri (acryloyloxyethyl) isocyanurate, polyester acrylate oligomer, 2-phenoxyethyl acrylate, 2-phenoxyethyl methacrylate, phenol ethoxylate monoacrylate, 2-(p-chlorophenoxy)ethyl acrylate, p-chlorophenyl acrylate, phenyl acrylate, 2-phenylethyl acrylate, (2-acryloxyethyl) ether of bisphenol A, ethoxylated bisphenol A diacrylate, 2-(1-naphthyloxy)ethyl acrylate, o-biphenyl methacrylate and o-biphenyl acrylate.

[0016]

Methacrylic acid esters, for instance, include tetramethylene glycol dimethacrylate, triethylene glycol dimethacrylate, neopentyl glycol dimethacrylate, trimethylolpropane trimethacrylate, trimethylolethane trimethacrylate, ethylene glycol dimethacrylate, 1,3-butanediol dimethacrylate, hexanediol dimethacrylate, pentaerythritol dimethacrylate, pentaerythritol trimethacylate, pentaerythritol tetramethacrylate, dipentaerythritol dimethacrylate, dipentaerythritol hexamethacrylate, sorbitol trimethacrylate, sorbitol tetramethacrylate, bis-[p-3-methacryloxy-2-hydroxypropoxy) phenyl]dimethylmethane, bis-[p-(acryloxyethoxyphenyl] dimethylmethane, 2,2-bis(4-methacryloyloxyphenyl)propane, and mehacrylic acid-2-naphthyl.

[0017]

Itaconic acid esters, for instance, include ethylene glycol diitaconate, propylene glycol diitaconate, 1,3-butanediol diitaconate, 1,4-butanediol diitaconate, pentaerythritol diitaconate and sorbitol tetraitaconate. Cotonic acid esters, for instance, include ethylene glycol isocrotonate, tetramethylene glycol dicrotonate, pentaerythritol dicrotonate, and sorbitol tetraocrotonate. The ester monomers of aliphatic polyvalent alcohol compounds and unsaturated carboxylic acids may include those classified as isocrotonic acid esters, for instance, ethylene glycol

diisocrotonate, pentaerythritol diisocrotonate, and sorbitol tetraisocrotonate.

[0018]

Maleic acid esters, for instance, include ethylene glycol dimaleate, triethylene glycol dimaleate, pentaerythritol dimaleate, and sorbitol tetramaleate. Halogenated unsaturated carboxylic acids, for instance, include 2,2,3,3-tetrafluoropropyl acrylate, 1H,1H,2H,2H-heptadecafluorodecyl acrylate, 2,2,3,3-tetrafluoropropyl methacrylate, 1H,1H,2H,2H-heptadecafluorodecyl methacrylate, methacrylic acid-2,4,6-tribromophenyl, dibromoneopentyl dimethacrylate (available under the trade name of NK Ester DBN, Shi-Nakamura Chemical Industries, Ltd.), dibromopropyl acrylate (available under the trade name of NK Ester A-DBP, Shin-Nakamura Chemical Industries, Ltd.), dibromopropyl methacrylate (available under the trade name of NK Ester DBP, Shin-Nakamural Chemical Industries, Ltd.), methacrylic acid chloride, methacrylic acid-2,4,6-trichlorophenyl, p-chlorostyrene, methyl-2-chloroacrylate, ethyl-2-chloroacrylate, n-butyl-2-chloroacrylate, tribromophenol acrylate, and tetrabromophenol acrylate.

[0019]

The amide monomers of unsaturated carboxylic acids and aliphatic polyvalent amine compounds, for instance, may include methylenebisacrylamide, methylenebismethacrylamide, 1,6-hexamethylenebisacrylamide, 1,6-hexamethylene-bismethacrylamide, diethylenetriaminetrisacrylamide, xylylenebisacrylamide, xylylenebismethacrylamide, N-phenylmethacrylamide, and diacetone acrylamide.

[0020]

Besides, the photo-polymerizable compounds may include polyisocyanate compounds having two or more isocyanate groups per molecule, as described in JP-B 48-41708, vinylurethane compounds having two or more polymerizable vinyl groups per molecule, with the addition thereto of a hydroxyl group-containing vinyl monomer represented by the following general formula (1):

[0021]

$$CH_2{=}C(R)COOCH_2CH(R')OH \qquad (1)$$

where R and R' each stand for a hydrogen atom or a methyl group), etc.

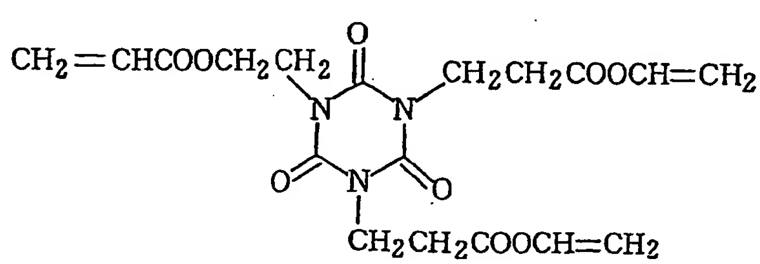
Urethane acrylates as set forth in JP-A 51-37193, and polyester acrylates, epoxy resins and polyfunctional acrylates or methacrylates such as (meth)acrylic acids as shown in JP-A 48-64183 and JP-B's 49-43191 and 52-30490, respectively, may also be used in the present invention. In addition, compounds referred to as photo-curable monomers and oligomers in The Journal of Adhesion Society of Japan, Vol. 20, No. 7, pp. 300-308 (1984) may be used. For the photo-polymerizable compounds used herein, use may further be made of phosphorus-containing compounds such as mono(2-acryloyloxyethyl) acid phosphate (available under the trade name of Light Ester PA, Kyoeisha Oil & Fat Chemical Industries, Ltd.), mono(2-methacryloyloxyethyl) acid phosphate (available under the trade name of Light Ester PM, Kyoeisha Oil & Fat Chemical Industries, Ltd.), epoxy acrylate compounds (available under the trade names of Ripoxy VR-60 and Ripoxy VR-90, Showa Polymer Co., Ltd.), and NK Ester M-230G and NK Ester 23G, both made by Shin-Nakamura Chemical Industries, Ltd.

[0022]

Use may further be made of triacrylates having the following structural forulae (2) and (3) and available under the trade names of Alonix M-315 and Alonix M-325, Toa Synthesis Chemical Industries, Ltd.):

[0023]

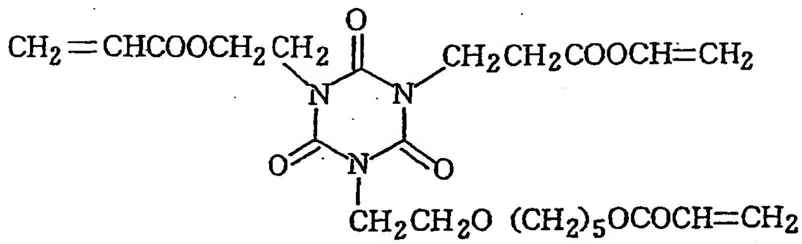
<u>Alonix M-315</u>



(2)

[0024]

Alonix M-325



(3)

Use may further be made of 2,2'-bis(4-acryloxy· diethoxyphenyl)propane (available under the trade name of NK Ester A-BPE-4, Shin-Nakamura Chemical Industries, Ltd.), tetramethylolmethane tetraacrylate (available under the trade name of NK Ester A-TMMT, Shin-Nakamura Chemical Industries, Ltd.), etc.

[0025]

If required, the plasticizer may be used herein. For instance, use may be made of polyvalent alcohols such as ethylene glycol, diethylene glycol, triethylene glycol, glycerin and trimethylolpropane; phthalate plastisizers such as dimethyl phthalate (DMP), diethyl phthalate (DEP), dibutyl phthalate (DBP), heptylnonyl phthalate (HNP), (di-2-ethylhexyl)phthalate (COP), di-n-octyl phthalate (DNOP), di-i-octyl phthalate (DCapP), 79 alkyl phthalate (D79P), di-i-decyl phthalate (DIDP), ditridecyl phthalate (DTDP), dicyclohexyl phthalate (DCHP), butylbenzyl phthalate (BDP), ethylphthalyl-ethyl glycolate (EPEG) and butylphthalyl-butyl glycolate (BPBG); aliphatic dibasic acid ester plasticizers such as (di-2-ethylhexyl)adipate (DIDA), (di-n-hexyl)azelate (DNHZ), (di-2-ethylhexyl)azelate (DOZ), dibutyl sebacate (DBS) and (d-2-ethylhexyl)sebacate (DOS); citrate plasticizers such as triethyl citrate (TEC), tibutyl citrate (TBC), acetyl triethyl citrate (ATEC) and acetyl tributyl citrate (ATBC); epoxy plasticizers such as epoxylated soybean oil; and phosphate plasticizers such as tributyl phosphate

(TBP), triphenyl phosphate (TPP), tricresyl phosphate (YCP) and tripropylene glycol phosphate.

[0026]

For the photo-polymerization initiator in the initiator system, for instance, 1,3-di(t-butyldioxycarbonyl) benzophenone, 3,3',4,4'-tetrakis(t-butyldioxycarbonyl) benzophenone, N-phenylglycine, 2,4,6-tris(trichloromethyl)-s-triazine, 3-phenyl-5-isooxazolone, 2-mercaptobenzimidazole, and imidazole dimers may be used. In view of the stabilization of the recorded hologram, the photo-polymerization initiator should preferably be removed by decomposition after hologram recording. For instance, organic peroxide initiators are preferred because of being easily decomposed by ultraviolet irradiation.

[0027]

Exemplary senstizing dyes are those having absorption light at 350 to 600 nm such as thiopyrylium salt dyes, merocyanine dyes, quinoline dyes, styrylquinoline dyes, ketocoumarin dyes, thioxanthene dyes, xanthene dyes, oxonol dyes, cyanine dyes, rhodamine dyes, pyrylium ion dyes, and diphenylidonium ion dyes. It is here noted that it is acceptable to use sensitizing dyes having absorption light at a wavelength less than 350 nm or greater than 600 nm.

[0028]

The matrix polymer used herein, for instance, includes copolymers (or a mixture thereof) comprising as a polymerization component or components at least one copolymerizable component selected from the group consisting of polymethacrylic acid ester or its partial hydrolysate, polyvinyl acetate or its hydrolysate, polyvinyl alcohol or its partially acetallized product, triacetyl cellulose, polyisoprene, polybutadiene, polychloroprene, silicone rubber, polystyrene, polyvinyl butyral, polyvinyl chloride, chlorinated polyethylene, chlorinated polypropylene, poly-N-vinylcarbazole or its derivative, poly-N-vinylpyrrolidone or its derivative, copolymer of styrene and maleic anhydride or its half ester, acrylic acid, acrylic acid ester, methacrylic acid, methacrylic acid ester, acrylamide, acrylnitrile,

ethylene, propylene, vinyl chloride and vinyl acetate. For the matrix polymer, it is more preferable to use polyisoprene, polybutadiene, polychloroprene, polyvinyl alcohol, polyvinyl acetal that is a partially acetallized product of polyvinyl alcohol, polyvinyl butyral, polyvinyl acetate, ethylene-vinyl acetate copolymer and vinyl chloride-vinyl acetate copolymer which may be used alone or in admixture. The recorded hologram is stabilized by the step of migrating the monomers by heating. To this end, these matrix polymers have to have a relatively low glass transition temperature and so make the migration of monomers easy.

[0029]

The photo-polymerizable compound should be used in an amount of usually 10 part by weight to 1,000 parts by weight, and preferably 10 parts by weight to 100 parts by weight, per 100 parts by weight of polymer matrix. The photo-polymerization initiator should be used in an amount of usually 1 part by weight to 10 parts by weight, and preferably 5 parts by weight to 10 parts by weight, per 100 parts by weight of polymer matrix. The sensitizing dye should be used in an amount of usually 0.01 part by weight to 1 part by weight, and preferably 0.01 part by weight to 0.5 parts by weight, per 100 parts by weight of polymer matrix. Other volume hologram-forming materials, for instance, are a variety of nonionic, anionic and cationic surface active agents.

[0030]

These hologram-recording materials are dissolved in a suitable solvent such as acetone, methyl ethyl ketone, methyl isobutyl ketone, cyclohexanone, benzene, toluene, xylene, chlorobenzene, tetrahydrofran, methyl cellosolve, ethyl cellosolve, methyl cellosolve acetate, ethyl cellosolve acetate, ethyl acetate, 1,4-dioxane, 1,2-dichloroethane, dichloromethane, chloroform, methanol, ethanol and isopropanol or a mixture thereof to form a coating solution having a solid content of 15% to 25%. The hologram-recording

layer should have a thickness of usually 0.1 to 50 μm, and preferably 1 to 20 μm as measured after drying.

[0031]

Next, reference is made to another embodiment of the present invention, wherein the hologram layer 2 is made up of a surface relief hologram layer. For the fabrication of the surface relief hologram, for instance, a hologram-forming layer is first formed by coating a surface relief hologram-forming material on a temporary substrate such as one represented by the aforesaid substrate 6. Then, a press stamper prepared from a master hologram using laser light is thermally pressed on the surface of the hologram-forming layer to form a fine relief pattern thereon. This hologram layer may be formed of every material used for conventional relief hologram-forming layers. By way of example but not by way of limitation, various resin materials such as thermosetting resins, thermoplastic resins and ionizing radiation-curing resins may be used. The thermosetting resins used herein, for instance, include unsaturated polyester resin, acrylic-modified urethane resin, epoxy-modified acrylic resin, epoxy-modified unsaturated polyester resin, alkyd resin and phenol resin, and the thermoplastic resins, for instance, include acrylate resin, acrylamide resin, nitrocellulose resin and polystyrene resin. These resins may be made up of homopolymers or copolymers comprising at least two components, and may be used alone or in combination of two or more. These resins may additionally contain various isocyanate compounds, metallic soaps such as cobalt naphthenate and zinc naphthenate, organic peroxides such as benzoyl peroxide and methyl ethyl ketone peroxide, thermal or ultraviolet curing agents such as benzophenone, acetophenone, anthraquinone, naphthoquinone, azobisisobutyronitrile and diphenyl sulfide, and so on.

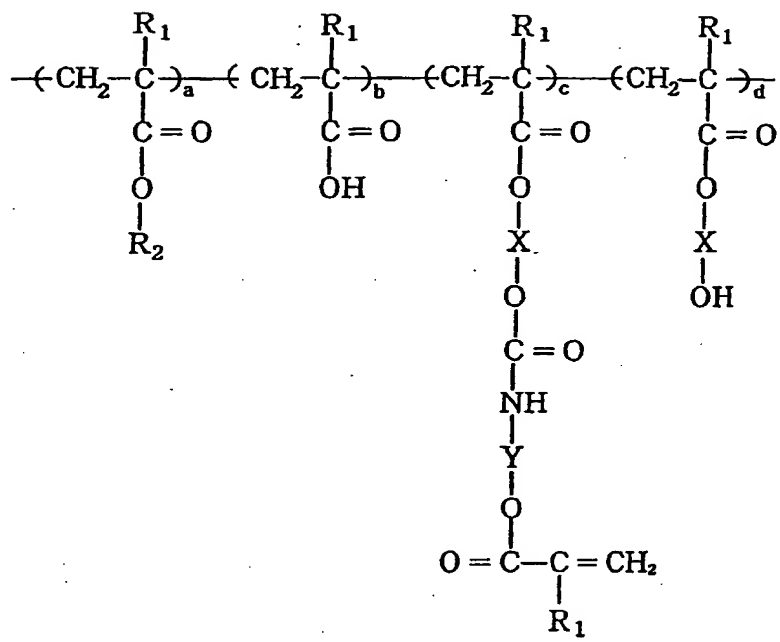
[0032]

The ionizing radiation-curable resins used herein, for instance, include epoxy-modified acrylate resins, urethane-modified acrylate resins and acrylic-modified polyesters. Of these, the urethane-modified acrylate resins are preferable,

although the urethane-modified acrylc resin represented by the following general formula is most preferred.

[0033]

General Formula



Here five R_1's are each independently a hydrogen atom or a methyl group, R_2 is a C_{1-16} hydrocarbon group, and X and Y are each a straight- or branched-chain alkylene group. On the premise that $(a+b+c+d) = 100$, a is an integer of 20 to 90, b is an integer of 0 to 50, c is an integer of 10 to 80, and d is an integer of 0 to 20.

One preferable example of the aforesaid urethane-modified acrylic resin is obtained by the reaction of methacryloyloxyethyl isocyanate(2-isocyanate ethyl methacrylate) with hydroxyl groups present in an acrylic copolymer obtained by the copolymerization of 20 to 90 moles of methyl methacrylate, 0 to 50 moles of methacrylic acid and 10 to 80 moles of 2-hydroxyethyl methacrylate.

[0034]

Thus, it is not required that the aforesaid methacryloyloxyethyl isocyanate react with all the hydroxyl group present in the copolymer; that is, only the reaction of methacryloyloxyethyl isocyanate with at least 10 mol%, and preferably at least 50 mol% of hydroxyl groups in the 2-hydroxyethyl methacrylate in the copolymer is needed. In place of or in combination with the aforesaid 2-hydroxyethyl methacrylate, hydroxyl-containing monomers may be used, for instance, N-methylolacrylamide, N-methylolmethacrylamide, 2-hydroxyethyl acrylate, 2-hydroxyethyl methacrylate, 2-hydroxypropyl acrylate, 2-hydroxyethyl methacrylate, 4-hydroxybutyl acrylate and 4-hydroxybutyl methacrylate.

[0035]

For instance, when a diffraction grating or the like is formed by a resin composition comprising as its main component the urethane-modified acrylic resin with many methacryloyl groups introduced in its molecule using the hydroxyl groups present in the hydroxyl group-containing acrylic resin, as mentioned above, it is possible to use ionizing radiation such as ultraviolet rays or electron beams as curing means. In addition, the resultant diffraction grating or the like is much more improved in flexibility, heat resistance, etc., albeit having a high crosslinking density.

[0036]

The aforesaid urethane-modified acrylic resin may be obtained by dissolving the aforesaid copolymer in a solvent such as toluene, ketone, cellosolve acetate or dimethyl sulfoxide to prepare a solution. While the solution is stirred, the methacryloyloxyethyl isocyanate is added dropwise thereto for the reaction of the isocyanate group with hydroxyl groups in the acrylic resin, yielding an urethan bond, through which the methacryloyl group can be introduced in the resin. Referring here to the amount of the methacryloyloxyethyl isocyanate used, the isocyanate group is used in an amount of 0.1 to 5 moles, and preferably 0.5 to 3 moles per hydroxyl group in the acrylic resin. It is then appreciated that when the methacryloyloxyethyl isocyanate is

used in excess of the equivalent of the hydroxy groups in the aforesaid resin, there is a possibility that a -CONH-CH_2CH_2- bond may occur through the reaction of said methacryloyloxyethyl isocyanate with carboxyl groups in the resin.

[0037]

While the present invention has been described with reference to the cases where all R_1's and R_2 are methyl groups and both X and Y are ethylene groups, it is understood that the present invention is not limited thereto. For instance, the present invention also includes the cases where five R_1's are each independently a hydrogen atom or a methyl group, R_2 is a methyl group, an ethyl group, an n- or iso-propyl group, an n-, iso- or tert-butyl group, a substituted or unsubstituted phenyl group, and a substituted or unsubstituted benzyl group, and X and Y are each an ethylene group, a propylene group, a diethylene group, and a dipropylene group. The thus obtained urethane-modified acrylic resin should have an overall weight-average molecular weight of 10,000 to 200,000, and preferably 20,000 to 40,000 as measured by GPC on a standard polystyrene weight basis.

[0038]

When such an ionizing radiation-curing resin is cured, the aforesaid monomers may be used in combination with such mono- or poly-functional monomers or oligomers as mentioned below for the purpose of control of crosslinked structure, viscosity, etc.

[0039]

Exemplary monofunctional monomers are mono(meth) acrylates such as tetrahydrofurfuryl (meth)acrylate, hydroxyethyl (meth)acrylate, vinyl pyrrolidone, (meth)acryloyloxyethyl succinate and (meth)acryloyloxyethyl phthalate. As classified in terms of skeleton structure, di- or poly-functional monomers include polyol (meth)acrylates such as epoxy-modified polyol (meth)acrylate, lactone-modified polyol (meth)acrylate, polyester (meth)acrylate, epoxy (meth)acrylate and urethane (meth)acrylate, and other poly (meth)acrylates having polybutadiene, isocyanuric acid, hydantoin, melamine, phosphoric acid, imide and phosphazine

skeletons. Thus, various monomers, oligomers and polymers capable of being cured by ultraviolet radiation and electron beams may be used.

[0040]

To be more specific, exemplary difunctional monomers and oligomers include polyethylene glycol di(meth)acrylate, polypropylene glycol di(meth)acrylate, neopentyl glycol di(meth)acrylate and 1,6-hexanediol di(meth)acrylate, and exemplary trifunctional monomers, oligomers and polymers are trimethylolpropane tri(meth)acrylate, pentaerythritol tri(meth)acrylate and an aliphatic tri(meth)acrylate. Exemplary tetrafunctional monomers, oligomers and polymers include pentaerythritol tetra(meth)acrylate, ditrimethylolpropane tetra(meth)acrylate and an aliphatic tetra(meth)acrylate. Exemplary penta- or poly-functional monomers, oligomers and polymers include dipentaerythritol penta(meth)acrylate and dipentaerythritol hexa(meth)acrylate. Besides, (meth)acrylates having polyester, urethane and skeletons may be used. Although the number of functional groups is not critical, it is appreciated that the number of functional groups of less than 3 makes heat resistance likely to become low, and the number of functional groups exceeding 20 makes flexibility likely to become low. It is thus preferred that the number of functional groups be in the range of 3 to 20.

[0041]

To form a relief hologram in the hologram-forming layer composed of the aforesaid materials, a press stamper with a relief pattern formed on its surface is pressed against the surface of the holgoram-forming layer to transfer the relief pattern onto the surface of the hologram-forming layer. Preferably in this case, a release agent should be previously incorporated in the hologram-forming layer so as to provide an easy release of the hologram-forming layer from the press stamper. For this release agent, use may be made of any of release agents known so far in the art, for instance, solid waxes such as polyethylene wax, amide wax and teflon powders, surface active agents based on fluorine and phosphoric ester,

and silicone. Particularly preferred release agents are modified silicones inclusive of (1) a side chain type modified-silicone oil, (2) a both-terminated modified-silicone oil, (3) a one-terminated type modified silicone oil, (4) a both side-terminated type modified silicone oil, (5) methylpolysiloxane containing trimethylsiloxysilicic acid (called silicone resin), (6) silicone graft acrylic resin, and (7) methylphenyl silicone oil.

[0042]

The modified silicone oils are generally broken down into reactive silicone oils and non-reactive silicone oils. The reactive silicone oils, for instance, include those modified by such groups as amino, epoxy, carboxyl, carbinol, methacryl, mercapto, reactive (at one end), and foreign functional groups, and the non-reactive silicone oils, for instance, include those modified by polyether, methylstyryl, alkyl, higher fatty acid ester, hydrophilic group, higher alkoxy, higher fatty acid, and fluorine.

[0043]

Of the aforesaid silicone oils, particular preference is given to that of the type having a group capable to reacting with the film-forming component in the hologram-forming layer. This is because such silicone oil reacts with the film-forming component as the hologram-forming layer cures, so that it is bonded thereto. For this reason, this silicone oil is unlikely to bleed out on the surface of the hologram layer with the relief pattern formed thereon, so that unique performance can be imparted to the hologram layer. In particular, this silicone oil is effective for improvements in the adhesion of the hologram layer to a deposited layer at an evaporation step. Such a surface relief hologram layer as mentioned above has a thickness of usually 0.1 to 50 μm, and preferably 1 to 20 μm.

For such a surface relief hologram, a reflective layer should preferably be formed between the hologram layer 2 and the second heat seal layer 3. When a light reflective metal thin film is used for the reflective layer, an opaque hologram is obtained, and when a transparent substance

different in the index of refraction from the hologram layer is used, a transparent hologram is obtained. In the present invention, both the reflective layers may be used. The reflective layer may be formed by known processes inclusive of sublimation, vacuum evaporation, sputtering, reactive sputtering, ion plating, and electroplating.

[0044]

For the light reflective layer for forming an opaque type hologram, for instance, use may be made of thin films of metals such as Cr, Ti, Fe, Co, Ni, Cu, Ag, Au, Ge, Al, Mg, Sb, Pb, Pd, Cd, Bi, Sn, Se, In, Ga and Rb and their oxides and nitrides, which may be used alone or in combination of two or more. Of these, metal thin films of Al, Cr, Ni, Ag and Au are especially preferred with a thickness of 1 to 10,000 nm, and preferably 20 to 200 nm.

[0045]

The thin film to form the transparent type hologram may be made of any desired material provided that it is of light transparency enough to produce a hologram effect. For instance, the thin film may be formed using a transparent material having a refractive index different from that of the resin for the hologram-forming layer. Although the refractive index of this transparent material may be higher or lower than that of the resin for the hologram-forming layer, it is understood that the refractive index difference is preferably at least 0.1, more preferably at least 0.5, and more preferably at least 1.0. Besides, metallic reflective films of up to 20 nm in thickness may be used. The transparent type reflective layer preferably used herein includes a titanium oxide (TiO_2) film, a zinc sulfide (ZnS) film, and a Cu·Al composite metal oxide film.

[0046]

Having the function of bonding the hologram layer 2 to an application member in a heat-sensitive fashion, the second heat seal layer 3 is provided on one surface of the hologram layer 2 obtained as mentioned above (via the reflective layer where the hologram layer is of the surface relief type). The heat seal layer 3 comprises a heat-sensitive adhesive based

on thermoplastic resins such as ethylene-vinyl acetate copolymer resins, polyamide resins, polyester resins, polyethylene resins, ethylene-isobutyl acrylate copolymer resins, butyral resins, polyvinyl acetate resins and their copolymer resins, cellulose derivatives, polymethyl methacrylate resins, polyvinyl ether resins, polyurethane resins, polycarbonate resins, polypropylene resins, epoxy resins, phenol resins, thermoplastic elastomers such as SBS, SIS, SEBS and SEPS, and reactive hot melt resins. In consideration of adhesion to the application member, an appropriate selection may be made from these resins. Exemplary application members are a polyvinyl chloride sheet, a polystyrene sheet, a PET sheet and a high-quality paper sheet. In view of adhesion to these sheets, for instance, preference is given to EVA resin such as V200 made by Mitsui Chemicals, Inc., ethylene-vinyl acetate copolymer resin such as AD1790-15 made by Toyo Morton Co., Ltd. and M-720AH made by DIC, polyester resin such as A-928 made by DIC, acrylic resin such as A-450 made by DIC, and vinyl chloride-acetate resin such as A-100Z-4 made by DIC.

[0047]

To provide the second heat seal layer 3 on the hologram layer 2, the heat-sensitive resin is dissolved or dispersed in a solvent such as toluene or methyl ethyl ketone to prepare a coating solution. Then, the coating solution is coated on a temporary carrier such as one represented by substrate 6 to a post-drying thickness of 2 to 10 μm by means of a comma coater, a die coater or a gravure coater to prepare a releasable heat seal-forming layer. Finally, this heat seal-forming layer is transferred by lamination on the hologram layer 2 with the hologram recorded therein.

[0048]

The first heat seal layer 4 is provided for the purpose of bonding the tackiness-free surface protective layer 5 to the tackiness-free hologram layer 2 coated and formed on the substrate 6 in a heat-sensitive fashion and as a barrier layer for preventing the migration of low-molecular-weight components such as organic solvents and surfactants from the

surface protective layer to the hologram layer and the migration of low-molecular-weight components such as monomers and organic solvent from the hologram layer to the surface protective layer. The same resins as mentioned in connection with the second heat seal layer may be used.

[0049]

To transfer the first heat seal layer 4 on the side of the hologram layer 2 facing away from the second heat seal layer 3 by means of dry lamination, the coating solution is coated on a temporary carrier such as one represented by substrate 6 as is the case with the second heat seal layer, thereby to form a barrier layer having a post-drying thickness of 0.5 μm to 10 μm.

[0050]

In the hologram transfer foil of the present invention, the first heat seal layer should have a softening point of 55°C to 200°C, preferably 55°C to 150°C, and the second heat seal layer should have a softening point of 50°C to 190°C, preferably 50°C to 145°C. In consideration of heat sealability with respect to the hologram layer, the first heat seal layer should have a softening point of 200°C or lower. It is not preferable to make the softening point of the first heat seal layer lower than that of the second heat seal layer, because high heat seal temperature is needed for transfer, resulting in misalignment due to the melting of the first heat seal layer, etc. That is, it is preferable that the softening point of the first heat seal layer is at least 5°C, preferably at least 10°C, higher than that of the second heat seal layer.

[0051]

The surface protective layer 5 must have adhesion to the first heat seal layer 4 and releasability from the substrate 6. After the substrate 6 is released off, the surface protective layer 5 cooperates with the first heat seal layer to serve as a protective layer for the hologram layer 2. Comprising a methacrylic resin such as polymethyl methacrylate as a main binder, the surface protective layer is required to have functions such as hard coatability,

printability and slip capability because it must serve as a protective layer for the volume hologram layer 2. To achieve such functions, various additives are incorporated in the surface protective layer. For the binder, polyacrylate resins, polyvinyl chloride resins, cellulose resins, silicone resins, chlorinated rubber, casein, etc. may also be used. For the additives, use may be made of surface active agents, waxes and metal compounds which may be used alone or in admixture.

[0052]

The surface protective layer 5 should preferably be formed using a material selected in such a way as to provide a peel force of 1 to 100 gf/inch (90° peeling), and preferably 1 to 5 gf/inch with respect to the substrate. The peel force between the surface protective layer 5 and the substrate 6 should be set such that when the hologram transfer foil of the present invention is applied on the heat seal layer side over an application member, it becomes smaller than that between adjacent layers in the multilayer structure, viz., between the surface protective layer and the barrier layer, between the barrier layer and the hologram layer, between the hologram layer and the heat seal layer, and between the heat seal layer and the application member. To form the surface protective layer, the starting composition is dissolved in an organic solvent to prepare an ink. Then, this ink is coated on the substrate 6 by known means such as coating. In consideration of releasability, tear capability and surface protection, the surface protective layer should preferably have a thickness of 0.1 μm to 3 μm.

[0053]

For the releasable sheet 7 provided on the second heat seal layer 3, use may be made of ordinarily used release paper as well as releasable films obtained by treating films such as polyethylene terephthalate or polypropylene films with releasing agents based on fluorine, silicone or the like. It is noted that even when no releasable sheet 7 is provided, a sheet form of hologram transfer foil 1 may be

superposed on itself or a continuous form of label may be rolled up. In this case, too, the heat seal layer has no adhesion to the upper surface of another label superposed thereon. Nonetheless, it is preferable to laminate the releasable sheet 7 on the heat seal layer because the surface of the heat seal layer can be surely protected during storage of hologram transfer foil 1.

[0054]

To the hologram transfer foil of the present invention, a first multilayer film (1) comprising a PET film/hologram layer 2 with a relief or volume hologram recorded therein/film with the surface subjected to releasing treatment, a second multilayer film (2) comprising a surface protective layer 5/substrate 6, a third multilayer film (3) comprising a first heat seal layer 4/film with the surface subjected to releasing treatment and a fourth multilayer film (4) comprising a second heat seal layer 3/releasable sheet 7 are first separately prepared.

[0055]

Then, the third multilayer film is dry laminated on its first heat seal layer side over the surface protective layer of the second multilayer film at 55°C to 200°C, thereby preparing a fifth multilayer film comprising a first heat seal layer 4/surface protective layer 5/substrate 6.

[0056]

Then, the film with the surface subjected to releasing treatment is released from the first multilayer film. Subsequently, the fifth multilayer film is dry laminated at 55°C to 200°C on its first heat seal layer surface over the surface of the hologram layer with the hologram recorded therein, thereby preparing a sixth multilayer film comprising a PET film/hologram layer 2/first heat seal layer 4/surface protective layer 5/substrate 6.

[0057]

Then, the PET film is removed from the sixth multilayer film. Finally, the fourth multilayer film is dry laminated at 50°C to 195°C over the surface of the hologram layer (the

surface of the reflective layer laminated on the hologram layer when the hologram layer is a relief hologram layer).

[0058]

In this way, the hologram transfer foil of the present invention comprising a releasable sheet 7/second heat seal layer 3/hologram layer 2/first heat seal layer 4/surface protective layer 5/substrate 6 can be obtained. This hologram transfer foil can be easily fabricated without havingany adverse influence on the hologram, because both the first and second heat seal layers are formed by transfer.

[0059]

To transfer the hologram onto the application member using the hologram transfer foil of the present invention, the releasable sheet 7 is first removed from the hologram transfer foil. Then, the hologram transfer foil is heat laminated on the surface of the second heat seal layer 3 over the application member at 60°C to 210°C, and preferably 100°C to 200°C, followed by removal of the sheet or carrier tape form of the substrate 6. In this way, a structure comprising the second heat seal layer 3/hologram layer 2/first heat seal layer 4/surface protective layer 5 can be formed on the surface of the application member.

[0060]

If, in the hologram transfer foil of the present invention, the transfer layer comprising the second heat seal layer 3/hologram layer 2/first heat seal layer 4/surface protective layer 5 is made transparent, it is then possible to directly see the surface of the application member that is the lower layer. For the application member, for instance, use may be made of paper, synthetic paper, plastic and metal films or sheets, glass or other transparent sheets, and opaque sheets. For plastics, use may be made of vinyl chloride resins, acrylic resins, polystyrene resins, polyester resins such as polyethylene terephthalate, and polycarbonate resins.

In what follows, the present invention is explained with reference to examples.

[0061]

Example 1

(First multilayer film comprising PET film/volume hologram formation layer/PET film with the surface subjected to releasing treatment

A coating solution having the following composition:

Photocurable resin composition for volume hologram layer formation (containing as a basic binder a polymethyl methacrylate resin (Tg: 100°C)	60 parts by weight
Methyl ethyl ketone	25 parts by weight
Toluene	15 parts by weight

was gravure coated to a post-drying thickness of 10 μm on a PET film (of 50 μm in thickness, Lumirror T60, Toray Industries, Inc.), and a PET film with the surface subjected to releasing treatment (of 50 μm in thickness, SP-PET, Tohcello Co., Ltd.) was laminated on the thus obtained coating surface. For the photocurable resin composition HRF-800X001 DuPont was used.

[0062]

Using laser light of 514 nm wavelength, a Lippmann hologram was recorded in the volume hologram layer in the first multilayer film. Then, to fix the Lippmann hologram, the first multilayer film was heated at 100°C for 10 minutes, and then used a high-pressure mercury lamp (3,000 mJ/cm^2).

[0063]

(Second multilayer film comprising surface protective layer 5/substrate 6)

Hakuri Nisu K53A (made by Showa Ink Industries, Inc.) was coated to a post-drying thickness of 1 μm on a substrate (of 50 μm in thickness, Lumirror T60 made by Toray Industries, Inc.), using a gravure coater, thereby forming a surface protective layer on the substrate.

[0064]

(Third multilayer film comprising first heat seal layer 4/film with the surface subjected to releasing treament)

A heat-sensitive adhesive (Nipporan 3038 made by Nippon Polyurethane Co., Ltd. with a softening point of 135°C) was coated to a post-drying thickness of 2 μm on a PET film with the surface subjected to releasing treatment (of 50 μm in

thickness, SP-PET made by Tohcello Co., Ltd.), using a gravure coater.

[0065]

(Fourth multilayer film comprising second heat seal layer 3/releasable sheet 7)

A heat-sensitive adhesive (V200 made by Mitsui Chemical Industries, Ltd.) was coated to a post-drying thickness of 2 μm on a PET film with the surface subjected to releasing treatment (of 50 μm in thickness, SP-PET made by Tohcello Co., Ltd.), using a gravure coater, to form a second heat seal layer on the releasable sheet.

[0066]

(Fifth multilayer film comprising first heat seal layer 4/surface protective layer 5/substrate 6)

The third multilayer film was dry laminated at 140°C on its first heat seal layer side over the surface protective layer of the second multilayer film, and the film with the surface subjected to releasing treatment was removed from the third multilayer film, thereby preparing the fifth multilayer film.

[0067]

(Preparation of the hologram transfer foil)

The PET film with the surface subjected to releasing treatment was removed from the first multilayer film with the hologram recorded therein. Then, the fifth multilayer film was laminated at 140°C on its first heat seal layer side over the surface of the hologram layer in the first multilayer film, thereby obtaining a sixth multilayer film comprising a PET film/volume hologram layer 2/first heat seal layer 4/surface protective layer 5/substrate 6.

[0068]

Subsequently, the PET film contiguous to the volume hologram layer was removed, and the fourth multilayer film was laminated at 90°C on its second heat seal layer side over the surface of the volume hologram layer. In this way, the hologram transfer foil of the present invention comprising a releasable sheet 7/second heat seal layer 3/volume hologram

layer 2/first heat seal layer 4/surface protective layer 5/substrate 6 was fabricated.

[0069]

The releasable sheet was released from the obtained hologram transfer foil. Then, this hologram transfer foil was laminated on a vinyl chloride card at 130°C and 0.7 MPa for 1.5 seconds. Just after the lamination (after the lapse of about 2 seconds), the substrate 6 was removed to observe the release interface. It was consequently found that the substrate 6 can be released from the surface layer 5 with no difficulty. This means that the inventive hologram transfer foil is improved in productivity.

[0070]

(Comparative Example 1)

A hologram transfer foil was prepared as in Example 1 with the exception that the third and fourth multilayer films were prepared as mentioned below.

[0071]

(Third multilayer film comprising first heat seal layer 4/film with the surface subjected to releasing treatment)

A heat-sensitive adhesive (EC1700 made by Chuo Rika Co., Ltd. with a softening point of 85°C) was coated on a PET film with the surface subjected to releasing treatment (of 50 μm in thickness, SP-PET made by Tohcello Paper Co., Ltd.) to a post-drying thickness of 2 μm by means of a gravure coater.

[0072]

(Fourth multilayer film comprising heat seal layer 3/ releasable sheet 7)

A heat-sensitive adhesive (EC1700 made by Chuo Rika Co., Ltd. with a softening point of 85°C) was coated to a post-drying thickness of 2 μm on a PET film with the surface subjected to releasing treatment (of 50 μm in thickness, SP-PET made by Tohcello Paper Co., Ltd.), using a gravure coater, to laminate the second heat seal layer on the releasable sheet.

[0073]

As in Example 1, the hologram transfer foil was transferred onto a vinyl chloride card. Just after the

lamination (after the lapse of about 2 seconds), the substrate 6 was removed to observe the release interface. As a result, the thermoplastic resin layer 4 was found to be released off the hologram layer 2. After the lapse of a few seconds, the temperature of the transferred product was lowered for removal of the substrate 6. The substrate 6 could be perfectly released from the surface protective film. However, some long time was needed for one transfer cycle. In other words, this hologram transfer foil was found to have a problem in connection with productivity.

[0074]

Examples 2-3 and Comparative Examples 2-6

The third multilayer film was prepared as in Example 1 with the exception that the materials shown in Table 1, given below, were used for the thermoplastic resin in the third multilayer film comprising first heat seal layer 4/film with the surface subjected to releasing treatment. Under otherwise the same conditions as in Example 1, hologram transfer foils were prepared.

[0075]

Each of the obtained hologram transfer foils was laminated on a vinyl chloride card as in Example 1 yet under the transfer conditions shown in Table 2, given below. Just after the lamination (after the lapse of about 2 seconds), the substrate 6 was removed from the surface protective layer 5 to observe the release interface. The results of evaluation of the release surface are also shown in Table 2.

[0076]

In Table 2, OO indicates that the substrate 6 can be released from the surface layer 5 with no difficulty just after the lamination (after the lapse of about 2 seconds), O indicates that there is no problem in connection with the releasability of the substrate 6 from the surface layer 5 just after the lamination (after the lapse of about 2 seconds), but some long time is needed for one transfer cycle, Δ indicates that there is some problem in connection with the releasability of the substrate 6 from the surface layer 5 just after the lamination (after the lapse of about 2

seconds), and X indicates that there is a grave problem in connection with the releasability of the substrate 6 from the surface layer 5 just after the lamination (after the lapse of about 2 seconds).

[0077]

Table 1

	Material	Softening Point
Ex. 2	AC3100, Chuo Rika	90°C
Ex. 3	EC909, Chuo Rika	100°C
Comp. Ex. 2	EV270, Mitsui Chemicals	41°C
Comp. Ex. 3	U206, Soken Chemicals	60°C
Comp. Ex. 4	EC1200, Chuo Rika	75°C
Comp. Ex. 5	AD1709, Toyo Morton	80°C

[0078]

Table 2

	Lamination Temp.			Results of Transfer
Ex. 2	100°C	130°C	1.5 sec.	O
Ex. 3	110°C	130°C	1.5 sec.	OO
Comp. Ex. 2	50°C	130°C	1.5 sec.	X
Comp. Ex. 3	70°C	130°C	1.5 sec.	X
Comp. Ex. 4	50°C	130°C	1.5 sec.	X
Comp. Ex. 5	70°C	130°C	1.5 sec.	Δ

From Table 2, it is appreciated that when the softening point of the first heat seal layer is at least 5°C higher than that of the second heat seal layer, improved transferability is obtained.

[0079]

(Example 4)

The first multilayer film comprising a PET film/relief hologram layer/reflective layer/PET film with the surface subjected to releasing treatmenet was prepared as in Example 1.

[0080]

(Exemplary preparation of ionizing radiation-curing type urethane-modified acrylic resin that is a relief hologram-forming material)

A 2-liter four-necked flask equipped with a cooler, a dropping funnel and a thermometer was charged with 40 grams of toluene and 40 grams of methyl ethyl ketone (MEK) together with an azo initiator. Then, a mixed solution of 22.4 grams of 2-hydroxyethyl methacrylate (HEMA), 70.0 grams of methyl methacrylate (MMA), 20 grams of toluene and 20 grams of MEK was added dropwise to the charged materials through the dropping funnel over about 2 hours for an 8-hour reaction at a temperature of 100 to 110°C, after which the reaction product was cooled down to room temperature.

[0081]

A mixed solution of 27.8 grams of 2-isocyanate ethyl methacrylate (Currens MOI made by Showa Denko K.K.), 20 grams of toluene and 20 grams of methyl ethyl ketone wad added to the reaction product for an addition reaction using dibutyltin laurate as a catalyst. Upon confirmation by IR analysis of the disappearance of an absorption peak of 2,200 cm^{-1} for the isocyanate group in the reaction product, the reaction was completed.

[0082]

The obtained resin solution was found to have a solid content of 41.0% and a viscosity of 130 mPa·sec. (at 30°C). As measured by GPC on a standard polystyrene basis, the resin solution had a molecular weight of 35,000 and the average amount of C=C bonds introduced per molecule was 13.8 mol%.

[0083]

(Preparation of photo-curable resin composition)

Resin solution produced as mentioned above (on a solid basis) 100 parts by weight

Releasing agent (trimethylsiloxysilicic acid-containing methylpolysiloxane KF-7312 made by the Shin-Etsu Chemical Co., Ltd.) 1 part by weight

Polyfunctional monomer (SR-399 made by Sirtomer Co., Ltd.) 10 parts by weight

Polyester acrylate (M-6100 made by Toa Synthesis Co., Ltd.) 10 parts by weight

Photosensitizer (Irgacure 907 made by Chiba Specialty Chemicals Co., Ltd.) 5 parts by weight

Each of the aforesaid components was diluted with methyl ethyl ketone to obtain a composition having a solid content regulated to 20%.

[0084]

(Preparation of reflection type surface relief hologram)

A release layer (Hakuri Nisu 45-3 made by Show Ink Industries, Inc.) was coated on a polyethylene terephthalate film (PET of 25 μm in thickness, Lumirror T60 made by Toray Industries, Inc.) at a rate of 20 m/min. by means of gravure coating, followed by drying at 100°C to volatilize off the solvent. In this way, a film comprising a release layer having a post-drying thickness of 1 g/m^2 and a PET layer was obtained.

[0085]

The photo-curable resin composition obtained as mentioned above was coated on the release layer of the film comprising the release layer/PET layer by means of a roll coater, followed by drying at 100°C to volatilze off the solvent. In this way, a photosensitive film for replication was obtained with a post-drying thickness of 2 g/m^2. The obtained film remained ungummed and so could be stored in a rolled form.

[0086]

A press stamper prepared from a master hologram made using laser light was set on an emboss roller in a replicaton system, and the thus obtained photosensitive film for replication was positioned on the feed side of the the system, so that the photosensitive film was thermo-pressed at 150°C to form a fine relief pattern thereon. Instead of this master hologram, it is acceptable to replicate a hologram from a master hologram using a resin plate and apply the replicated hologram on a cylinder.

[0087]

Then, the photosensitive film was photo-cured by irradiation with ultraviolet rays from a mercury lamp, and an aluminum layer was subsequently deposited by vacuum evaporation on a fine relief pattern, thereby forming a reflection type relief hologram. Finally, a PET film with

the surface subjected to releasing treatment was applied over the surface of the relief hologram, thereby fabricating a first multilayer film.

[0088]

(Preparation of the hologram transfer foil)

The PET film contiguous to the release layer was removed from the multilayer film with the hologram recorded therein. Then, the fifth multilayer film obtained in Example 1 was laminated at 90°C on its first heat seal layer side over the surface of the hologram layer of the multilayer film, thereby obtaining a multilayer film comprising a PET film with the surface subjected to releasing treatment/reflective layer/surface relief hologram layer 2/first heat seal layer 4/surface protective layer 5/substrate 6.

[0089]

Then, the PET film with the surface subjected to releasing treatment was removed from the mutlilayer film, and the fourth multilayer film obtained in Example 1 and comprising the heat seal layer/releasable sheet was laminated at 90°C on its second heat seal layer side over the surface of the reflective layer of the multilayer film. In this way, the hologram transfer foil of the present invention comprising a releasable sheet 7/second heat seal layer 3/reflective layer/hologram layer 2/first heat seal layer 4/surface protective layer 5/substrate 6 was obtained.

[0090]

The obtained hologram transfer layer, from which the releasable sheet was removed, was heat transferred onto a vinyl chloride substrate at 130°C and 0.7 MPa for 1.5 seconds. Just after the lamination (after the lapse of about 2 seconds), the substrate 6 was removed to observe the release interface. It was consequently found that the substrate 6 can be released from the surface layer 5 with no difficulty. This means that the inventive hologram transfer foil is improved in productivity.

[0091]

EFFECT OF THE INVENTION

According to the present invention, there can be provided a hologram transfer foil which enables a hologram image, etc. to be reconstructed in an uninterrupted manner, and is improved in terms of productivity because of the preparation of each layer by heat lamination.

BRIEF EXPLANATION OF THE DRAWING

Fig. 1 is illustrative in section of one embodiment of the transparent hologram transfer foil according to the present invention.

EXPLANATION OF THE REFERENCE NUMERALS

Reference numeral 1 is a hologram transfer foil, 2 a hologram layer, 3 a second heat seal layer, 4 a first heat seal layer, 5 a surface protective layer, 6 a substrate, and 7 a releasable sheet.

NAME OF THE DOCUMENT

ABSTRACT OF THE DISCLOSURE

ABSTRACT

OBJECT

The invention has for its object to provide a hologram transfer foil which enables a hologram image, etc. to be reconstructed in an uninterrupted manner, and is improved in terms of productivity.

RESOLVING MEANS

A hologram transfer foil 1 is provided, which comprises a substrate 6 and a transfer layer laminated thereon, said transfer layer comprising a surface protective layer 5, a first heat seal layer 4 having a softening point of 55°C to 200°C, a hologram layer 2 and a second heat seal layer 3 having a softening point of 50°C to 195°C in this order. The softening point of the first heat seal layer is at least 5°C higher than the softening point of the second heat seal layer, and at the time when the hologram transfer foil is applied on said heat seal layer side to an application member, the peel force between said substrate and said surface protective layer is smaller than that between adjacent layers in other layers.

REFERRED-TO DRAWING

FIG. 1

【書類名】　図面
(DOCUMENT NAME)　　Drawing
【図１】 (FIG. 1)